

IN THE SPECIFICATION

Please replace the paragraph beginning at page 1, line 10, with the following rewritten paragraph:

The present invention relates to a guide apparatus for guiding an advancing continuous fiber bundle, a winding machine for winding the fiber bundle on a bobbin, a method for making a bobbin of a continuous fiber bundle, and the bobbin itself. Specifically, the present invention relates to a winding machine for winding a tape-like fiber bundle having a widened flat cross section on a bobbin and to a bobbin of a continuous bundle of carbon fibers. Further, the present invention relates to a winding machine which is equipped with the guide apparatus and by which a tape-like fiber bundle as a reinforcement can stably be wound on a bobbin in a state wherein the widened flat cross section is maintained.

Please replace the paragraph beginning at page 1, line 22, with the following rewritten paragraph:

As a reinforcement for fiber reinforced composite materials, carbon fibers, glass fibers, aramid (aromatic polyamide) fibers have been used. Among them, carbon fibers have been employed as reinforcement in the uses for aircrafts, sporting-goods such as golf shafts and fishing rods, and supplies in general industries, since the carbon fibers are excellent in specific strength, specific modulus, thermal resistance, and resistance to chemicals. In order to obtain carbon fibers having a high strength and a high modulus, a fiber bundle of carbon fiber precursors which is small in fiber breakage and fluff occurrence, and excellent in qualities is required. Heretofore, as the fiber bundle of precursors, that comprising 3,000 to 24,000 filaments has mainly been employed.

Please replace the paragraph beginning at page 2, line 7, with the following rewritten paragraph:

In recent years, carbon fibers came to widely be used up to general industrial uses such as construction, civil engineering, automobiles, energy, and compounds, and thus, so called large tows comprising more than 24,000 filaments having a high strength and a high modulus, and excellent in productivity have strongly been demanded. Carbon fibers are infrequently used only by themselves from the view points of their shapes and other characteristics. In many cases, carbon fibers are impregnated with a resin such as an epoxy resin after a plurality of fiber bundles were arranged in parallel to each other to prepare impregnated fiber bundles (this is generally called as a prepreg), wound into a cylindrical shape or put on a molded product to be covered, and then heated to cure the resin thereby obtain a fiber reinforced plastic molded product as final product.

Please replace the paragraph beginning at page 2, last line, with the following rewritten paragraph:

In order to reduce the weight per unit ~~are~~ area of a carbon fiber prepreg, it is necessary to widen the carbon fiber bundles to thin, and thus various plans have been elaborated by carbon fiber manufacturers now producing prepregs.

Please replace the paragraph beginning at page 3, line 4, with the following rewritten paragraph:

However, if the width of the fiber bundle, as a reinforcement, such as carbon fiber bundle supplied at a step for preparing a prepreg was increased in advance up to a certain width, that is, if the fiber bundle as a reinforcement wound on a bobbin was in a shape of widened tape-like fiber bundles, it is possible to omit the work for increasing the width of the

fiber bundles at a step of preparing a prepreg. Accordingly, a case wherein a widened tape-like fiber bundle as a reinforcement wound on a bobbin is used for preparing a light stuff prepreg has recently been increased.

Please replace the paragraph beginning at page 4, line 18, with the following rewritten paragraph:

The guide apparatus described in the Laid-open Japanese Patent Publication No. Hei 4-119123 has a fixed stand for a plate-like yarn guide which stand is stood up at a right angle with a traverse arm disposed in parallel to the axis of a bobbin and slid along the traverse arm, and guide rolls for guiding a fiber bundle are disposed above and below the fixed stand yarn guide. The lower guide roll is composed of a single roll disposed in parallel to the axis of a take-up bobbin, and the guide roll disposed above the fixed stand for the yarn guide is composed of a pair of parallel guide rolls crossing at right angle with the axial line of the take-up bobbin. While a widened fiber bundle is twisted 90° toward the direction of the axis line of the bobbin between the upper and lower guide rolls, the tape-like fiber bundle can be wound on the bobbin in a state wherein its widened shape is still maintained by passing the fiber bundle through the upper and lower guide rolls.

Please replace the paragraph beginning at page 5, last line, with the following rewritten paragraph:

However, in the guide apparatus described in the Laid-open Japanese Patent Publication No. Hei 10-330038 mentioned above, any consideration is not given to the width of a fiber bundle having a large fineness. In this patent publication No. Hei 10-330038, the apex angle of the cone guides is proposed to be 45° to 120° and preferably 60° to 90°.

However, in this range of the apex angle, there is a fear that a sufficient "length" of a roll

surface with which a crosswise portion (a line in the crosswise direction) of a fiber bundle contacts can not be secured when a fiber bundle having a large fineness is wound in a case where accommodation of all traverse mechanisms in a space limited from the arrangement of bobbins in a winding apparatus is intended. In other words, when a sufficient length of the oblique line of a conical guide against the width of a fiber bundle having a large fineness was intended to secure in a case wherein the apex angle of conical guide described above was adopted, the diameter itself of the bottom face of the conical guide becomes large, and thus, there is a fear that all of the traverse mechanisms can not be accommodated in the space of a winding apparatus in which a large number of bobbins are already disposed.

Please replace the paragraph beginning at page 6, line 20, with the following rewritten paragraph:

Besides, when the guide apparatus described in the Laid-open Japanese Patent Publication No. Hei 4-119123 mentioned above was adopted, the maintenance of the shape of a fiber bundle at the time of reversal in a traverse and winding of a fiber bundle is excellent compared with the case wherein the guide apparatus described in the Laid-open Japanese Patent Publication No. Hei 10-330038 mentioned above is used. However, since the distance between the guide rolls respectively disposed above and below the fixing stand in the guide apparatus is restricted by design ~~specification~~ specifications and the distance is short, a large torsional force acts on a fiber bundle at the step of twisting the fiber bundle 90° toward the direction of the axis line of a bobbin between the upper guide roll and the lower guide roll, when the number of filaments in one fiber bundle is increased and thus the width of the fiber bundle was also increased. Accordingly, the shape of the widened fiber bundle comes to be lost.

Please replace the paragraph beginning at page 7, line 9, with the following rewritten paragraph:

The present invention was produced for the purpose of solving the conventional problems described above, and an object of the present invention is to provide a guide apparatus with which a fiber bundle, as reinforcement for fiber reinforced composite materials, having a width increased into a tape-like fiber bundle can stably be guided in an untwisted condition, and to provide a winding machine with which a widened fiber bundle can stably be wound on a bobbin while maintaining the untwisted condition, ~~some-times~~ sometimes under a condition wherein the width of the fiber bundle is further increased than that of a fiber bundle at the time of being supplied, by merely installing the guide apparatus to an existing winding machine. Another object of the present invention is to provide a method for making a bobbin of a fiber bundle and a bobbin of a bundle of carbon fibers.

Please replace the paragraph beginning at page 8, line 1, with the following rewritten paragraph:

a pair of guides both of which are disposed on the passage on which the fiber bundle is advanced and the axis lines of which guides are in a relation such that they are twisted away from each other in a given space, and

Please replace the paragraph beginning at page 9, line 20, with the following rewritten paragraph:

The length of the face where the fiber bundle contact on the first guide is satisfactorily selected according to the fineness and width of a fiber bundle, but the length in the range of 20 mm to 150 mm is preferably used. Further, in a case wherein the first guide is a flat roll having a rotation mechanism, while the diameter of the guide is moved in the direction

parallel to the axis line of a bobbin by a traverse mechanism and decided only by the limit in the space for disposing bobbins of a winding machine, it is preferable to make the diameter range from 10 mm to 50 mm. Still further, when a conical guide is used as the first guide, the length of oblique line of the guide with which a fiber bundle contacts first and the axis line of which crosses at right angle with that of a bobbin is desirably 20 mm to 150 mm. In this case, the apex angle of the conical guide is preferably in the range of less than 45° in order to secure the length of the oblique line described above, since the dimensions and shape of the guide are subjected to the constraints of the space in which bobbins of a winding machine are disposed, just as in the case wherein the first guide is a flat roll.

Please replace the paragraph beginning at page 12, line 3, with the following rewritten paragraph:

The parallel guide roll ~~is~~serves to further twist a fiber bundle supplied through a conical guide roll disposed above the parallel guide roll toward the direction parallel to that of a bobbin to further widen the fiber bundle into a tape-like one. As the parallel roll, one cylindrical roll is usually employed, but when it is desired to still further widen the fiber bundle, it is possible to use a plurality of parallel guides as described in Laid-open Japanese Patent Publication No. Hei 10-330038 or use a plurality of parallel guide rolls at least one of which has a shape of a large hand drum trunk of which has a curved circumferential surface bulged at its center portion as described in Laid-open Japanese Patent Publication No. 2001-348166.

Please replace the paragraph beginning at page 15, line 8, with the following rewritten paragraph:

Although the winding machine of the present invention is most suitable when a widened flat tape-like fiber bundle, particularly a bundle comprising a large number of carbon fiber filaments is to be wound, the winding machine can be applied to various ~~type~~ types of fiber bundles as a matter of course.

Please replace the paragraph beginning at page 16, line 6, with the following rewritten paragraph:

The meanings of the ~~symbols~~ reference numbers used in the drawings are as follows:

Please replace the paragraph beginning at page 16, last line, with the following rewritten paragraph:

Now, the preferred embodiments of the present invention are specifically described with reference to the drawings. As carbon fibers, (a) PAN type carbon fibers obtained by heating acrylic fibers, as starting material, in an air environment to make the fibers flame resistant and then further heating the resulting flame resistant fibers in a nitrogen gas to carbonize, and (b) pitch type carbon fibers obtained by using, as a starting material, a pitch derived, for example, from a petroleum have been known, and the present invention can be applied when winding either type of carbon fibers on a bobbin.

Please replace the paragraph beginning at page 18, line 17, with the following rewritten paragraph:

The first guide 4 is composed of a flat guide, and this may be a fixed guide or flat roll having a rotation mechanism. As its construction material, any material including a steel applied with a satin plating, applied with a mirror plating, or coated with a resin such as a ~~Teflon~~ TEFLON coating can be used. While the first guide 4 may be a conical fixed guide or

conical roll having a rotation mechanism other than a flat guide, when a conical guide is adopted, the axis line of the guide is arranged so that a portion of the guide with which an advancing fiber bundle contacts first and which corresponds the oblique line of a cone becomes perpendicular to axis line 1a of bobbin 1 as shown in Fig. 2. At this time, while the length of the portion of the first guide 4 with which a fiber bundle contacts depends on the fineness of a fiber bundle or the width of a fiber bundle supplied, the length is usually 20 mm to 100mm, preferably 30 mm to 80 mm in consideration of the space in which bobbin 1 of a winding machine is disposed when a flat guide is used. The diameter of the guide is preferably 10 mm to 50 mm, more desirably 20 mm to 40 mm from the view point of the space for disposing the bobbin. Further, even when a conical fixed guide or roll is used as the first guide 4, the length of the oblique line where a fiber bundle contacts first is usually 20 mm to 120 mm, preferably 30 mm to 100 mm, and the diameter of the bottom face of the cone is preferably 10 mm to 50mm, more desirably 20 mm to 40 mm.

Please replace the paragraph beginning at page 21, line 12, with the following rewritten paragraph:

As shown in Fig. 1, a first fixed guide roll 3 and a second fixed guide roll 2 may be disposed in parallel ~~to~~ with the axis line 1a of the bobbin 1 and above the winding portion.

Please replace the paragraph beginning at page 23, line 24, with the following rewritten paragraph:

Fig. 5 shows a schematic side view of a winding machine of the present invention in which guide apparatus 10 of the present invention is installed, dancer roll 12 is disposed between the first fixed guide roll 11 (common upper fixed guide roll) and the guide apparatus 10 mentioned above, and a system (or mechanism) for controlling the tension of a fiber

bundle by controlling the rotation of bobbin 1 based on the quantity of the displacement of dancer roll 12 is provided. In this connection, the winding machine shown in Fig. 5 does not have a plurality of the first fixed guide rolls 3 disposed for each of the guide apparatuses 10 like the winding machine shown in Fig. 1, but has a single guide roll 11 ~~in-stead~~ instead, used for every guide apparatuses 10 in common.

Please replace the paragraph beginning at page 26, line 19, with the following rewritten paragraph:

A guide apparatus (10) as shown in Fig. 1 and Fig. 2 was manufactured and used as guide in a winding machine type KTW-C manufactured by KAMITSU SEISAKUSHO LTD. As the drive for rotating a bobbin (1) in the winding portion, a torque motor drive method was employed. At this time, a cylindrical flat guide attached to a frame 8 was used as first guide (4), the length of the portion of the roll with which a fiber bundle contacts was decided to be 60 mm, and the diameter of the roll was decided to be 25 mm. As second guide (5), a conical fixed guide having an apex angle of 15° and a height of cone of 60 mm was used, and the second guide (5) was arranged so that the angle (0) formed with axis line 1a of bobbin 1 becomes 57.5° as shown in Fig. 3. The steel surfaces of both of these first guide (4) and second guide (5) were applied with satin plating. As parallel guide roll (6), a steel roll having a diameter of 15 mm, a length of roll surface (roll width) of 75 mm, and a roll surface applied with satin plating was used. As upper first fixed guide roll (2) to be positioned in an upper portion of a winding portion, a flat roll having a diameter of 40 mm and a length of 80 mm was used. As upper second fixed guide roll (3), a hand drum-like roll having a curved circumferential surface depressed at its center portion was used, and the roll was designed so that the curved surface had a part of a circular arc having a radius of 45 mm, the diameter was 50 mm at the most depressed portion, and the roll length was 50 mm.

Please replace the paragraph beginning at page 28, line 17, with the following rewritten paragraph:

In the Example, as the second fixed guide roll (11), a roll having a diameter of 76.2 mm was used. The length of this roll was decided to be 127 mm and was used in consideration of the fact that 4 fiber bundles were to be supplied. As dancer roll (12) and the third fixed guide roll (13), flat rolls having a diameter of 50.8 mm and a roll length of 50.5 mm were used equally. By using a winding machine equipped with such guide rolls, a bundle of carbon fibers was wound on a take-up roll made of paper (paper tube). As the paper tube, a tube having an outer diameter of 82 mm and a length of 305 mm was used, and the width of traverse was adjusted to 252.4 mm.

Please replace the paragraph beginning at page 29, line 12, with the following rewritten paragraph:

As described above in detail, in preferable embodiments of the guide apparatus of the present invention, which apparatuses are used in a winding machine for winding a continuous fiber bundle, for example, a bundle of carbon fibers, two pairs of guide rolls and guide members (total four) shapes of which guide rolls and guide members in each pair are different from each other, are disposed on a guide stand to be traversed; the ~~motion of~~ traverse motion is cancelled out by the former first and second fixed guide rolls; and the fiber bundle is stably twisted 90° toward the direction of the axis line of a bobbin while maintaining the shape of the fiber bundle by the succeeding pair of the first and the second guides; and the fiber bundle can be supplied along a circumferential direction of the bobbin by the last parallel guide and a press roll. As the result, a fiber bundle widened into a tape-like shape can be wound on a bobbin in a stabilized shape.